REMARKS

Reconsideration of this application, as amended, is respectfully requested. Claims 1, 3, 5-13, 15-17, 19, 26 and 27 are pending. Claims 1, 3, 5-13, 15-17, 19, 26 and 27 stand rejected.

Claims 1 and 11 have been amended. Claims 2 – 5, 8, 10, 12, 13, 19, and 26 have been cancelled. Claims 32 - 39 have been added. Support for the amendments is found in the specification, the drawings, and in the claims as originally filed. Applicants submit that the amendments do not add new matter.

Rejections Under 35 U.S.C. § 103(a)

Claims 1, 3, 5-13, 15-17, 19, 26 and 27 stand rejected under 35 U.S.C. § 103 as being unpatentable over U.S. Patent No. 6,114,413 of Kang et al. ("Kang") in view of U.S. Patent No. 4,869,954 of Squitieri ("Squitieri") and U.S. Patent No. 6,365,973 of Koning ("Koning").

The Examiner has rejected claims 1, 3, 5-13, 15-17, 19, 26 and 27 under 35 U.S.C. § 103 as being unpatentable over Kang in view of Squitieri and Koning. The Examiner has stated that

> Kang discloses (figures 1-3, 5, column 2, lines 59-63 and column 4, lines 28-36) that a thermal interface material comprising a polymer paste material (polymer) acts as an adhesive; a fusible filler (Sn) coated onto a plurality of non-fusible particles (Cu) which has a sphere shape or a non-uniformly shape; and the pre-coated non-fusible particles randomly positioned with the binder material.

(p. 4, Office Action 7/28/04)

Applicants respectfully submit, however, that claim 1 is not obvious under 35 U.S.C. § 103 in view of Kang and Squitieri and Koning. Claim 1 includes the following limitations.

> A thermal interface material, comprising:
> a binder material; and
> a fusible filler within the binder material, the fusible filler randomly positioned with respect to the binder material and forming columnar structures within the binder material, the columnar structures formed during a reflow process from a plurality of fusible filler particles such that a cross-sectional area of the columnar structures is greater than a cross-sectional area of the fusible filler particles.

(Amended claim 1) (emphasis added)

In contrast, neither Kang nor Squitieri and Koning disclose these limitations.

Kang discloses that

> Another aspect of the present invention is a method of forming a thermally conductive joint between two surfaces by forming a paste of particles, having a conductive coating and a polymeric material, wherein the paste is disposed between two surfaces to be adhesively and thermally joined.

(Kang, Col. 2, lines 59-63).

Kang also discloses that

> FIG. 2 illustrates a thermally conductive paste (TCP) material 30, according to the present invention, comprising particles 34 having a thermally conducting coating 32, as conducting filler materials, and a polymer matrix 36. Particles 34 are preferably Cu particles. Any powder material with a high thermal conductivity, such as diamond, aluminum nitride, etc., coated with metals such as Cu, Ni or Pd can also be used instead of copper.

(Kang, Col. 4 lines 28-36).

Kang also discloses that

> high conductivity powder materials such as diamond, aluminum nitride, boron nitride, etc., coated with metals such as Cu, Ni or Pd, and coated with low melting point metals such as Sn, In, Bi, Sb, and others, mixed with an environmentally-safe fluxing agent, and polymer resins.

(Kang, Col. 6, lines 44-49)

Kang also discloses that

> an optimized formulation for the thermal via or thermal plug application, comprising tin-coated copper powder of 30 to 90% in weight, polyimide siloxane, NMP solvent, and butyric acid and ethylene glycol or no-clean flux

(Kang, Col. 6, lines 39-43)

Kang also discloses that

> an optimized formulation for the die attach application, comprising indium-coated copper powder of 30 to 90% in weight, polyimide siloxane, NMP solvent, and butyric acid and ethylene glycol or no-clean flux.
>
> an optimized formulation for the direct attach of heat spread application, comprising indium-coated copper powder of 30 to 90% in weight, polyimide siloxane, NMP solvent,

and butyric acid and ethylene glycol or no-clean flux.

an optimized formulation for the thermal via or thermal plug application, comprising tin-coated copper powder of 30 to 90% in weight, polyimide siloxane, NMP solvent, and butyric acid and ethylene glycol or no-clean flux.

high conductivity powder materials such as diamond, aluminum nitride, boron nitride, etc., coated with metals such as Cu, Ni or Pd, and coated with low melting point metals such as Sn, In, Bi, Sb, and others, mixed with an environmentally-safe fluxing agent, and polymer resins.

(Kang, Col. 6, lines 30-49)

Applicants respectfully submit that neither Kang, Koning, or Squitieri disclose a TIM having fusible filler fused into columnar structures such that the columnar structures have a greater cross-sectional area than the fusible filler particles. For this reason applicants respectfully submit that amended claim 1 is not rendered obvious by any of Kang, Koning, or Squitieri, alone or in combination. Given that claims 6, 7, 9, 11, 15 – 17, and 27 depend, directly or indirectly, from claim 1, applicants respectfully submit that claims 6, 7, 9, 11, 15 – 17, and 27 are, likewise, not rendered obvious by the cited references. Further, given that new claim 32 includes the limitation of fusible filler fused into columnar structures such that the columnar structures have a greater cross-sectional area than the fusible filler particles, and that claims 32-39 depend, directly or indirectly, from claim 32, applicants respectfully submit that claims 32 - 39 are, likewise, not rendered obvious by the cited references.

It is respectfully submitted that in view of the amendments and arguments set forth herein, the applicable rejections and objections have been overcome. If there are any additional charges, please charge Deposit Account No. 02-2666 for any fee deficiency that may be due.

Respectfully submitted,

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